AGS CNI Polarimeter 2011

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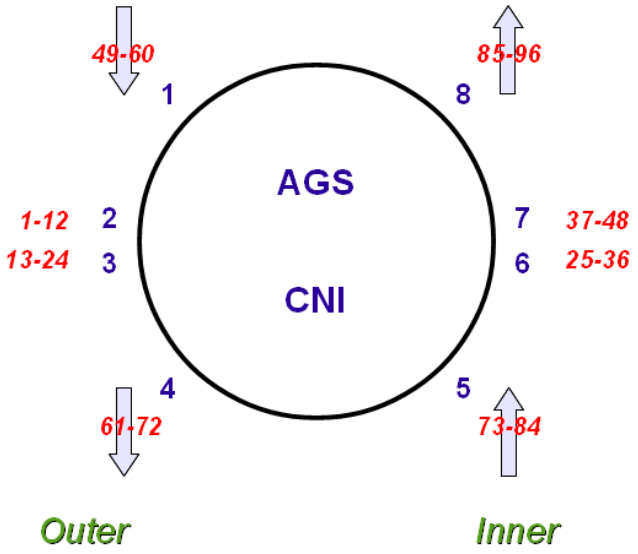
3 different detector types:



1,8 - Hamamatsu, slow preamplifiers

2,3,6,7 - BNL, fast preamplifiers

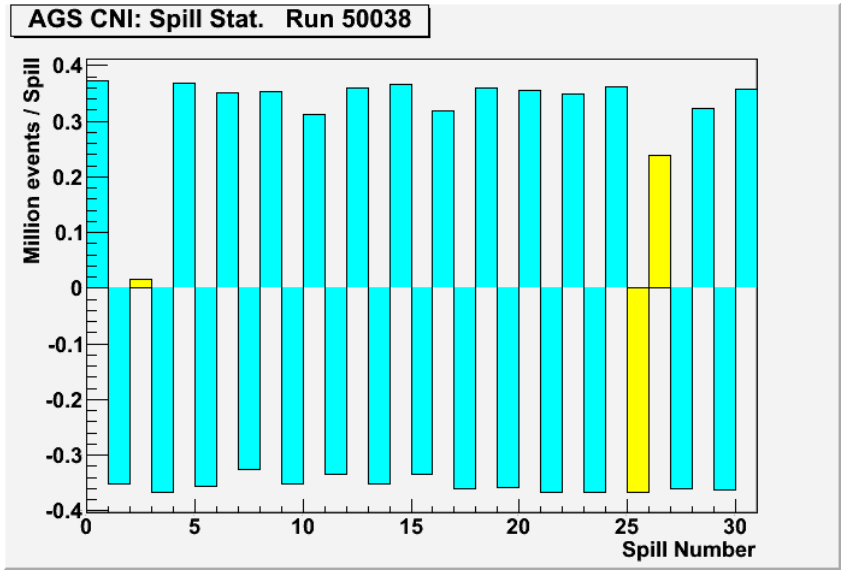
4,5 - Hamamatsu, fast preamplifiers

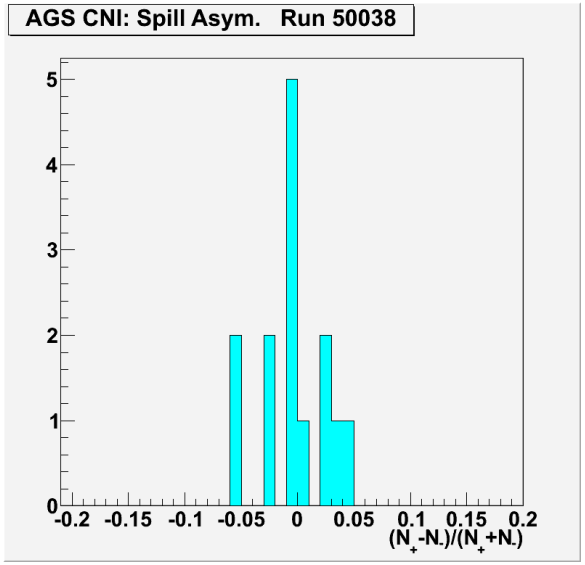
Run 2009: BNL, slow preamplifiers

Larger length (50 cm)

Regular length (30 cm)

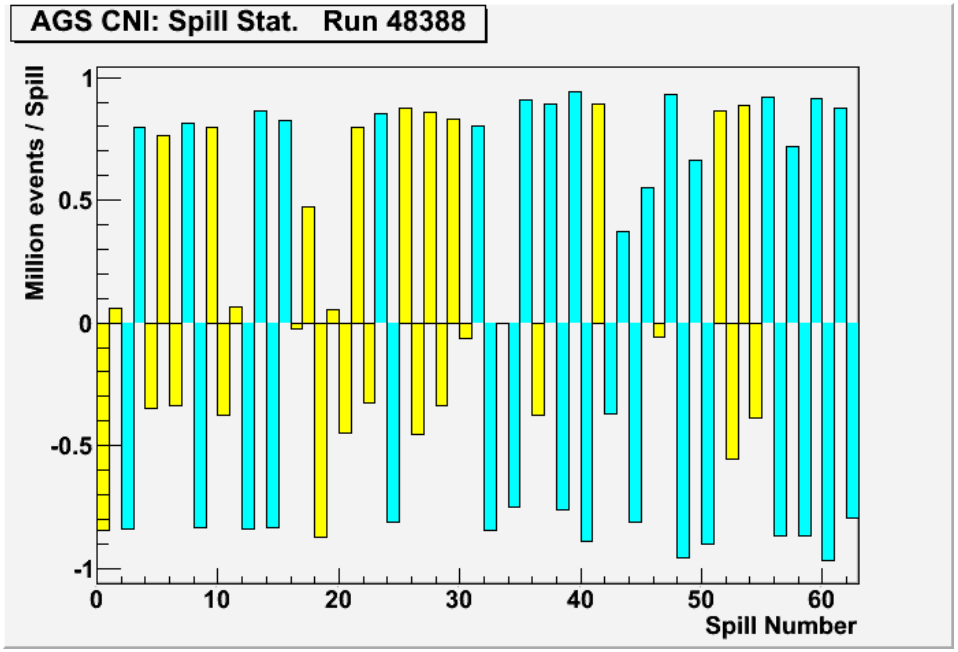
Spill Selection



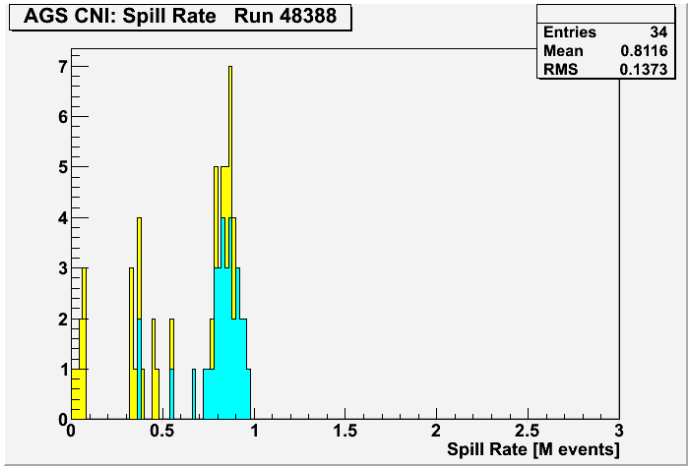


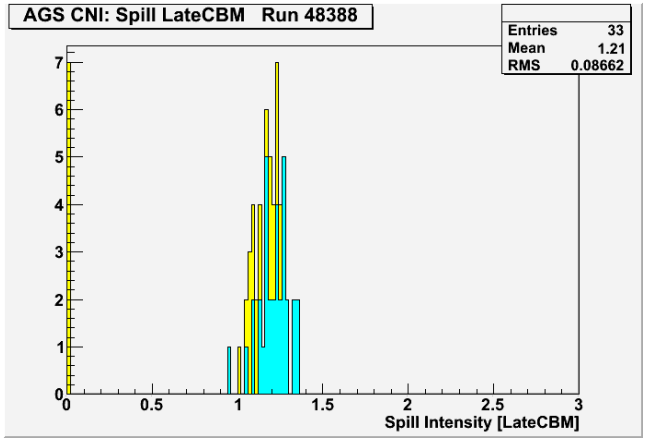
Only pairs of consecutive spills with opposite polarization and approximately equal intensity were selected for analysis.

Spill Selection: Bad Run Example

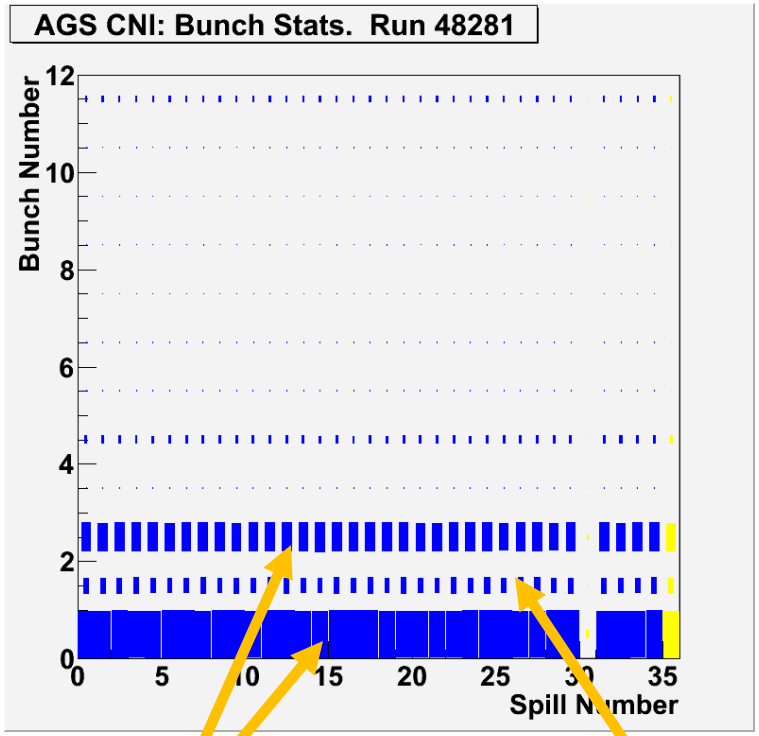


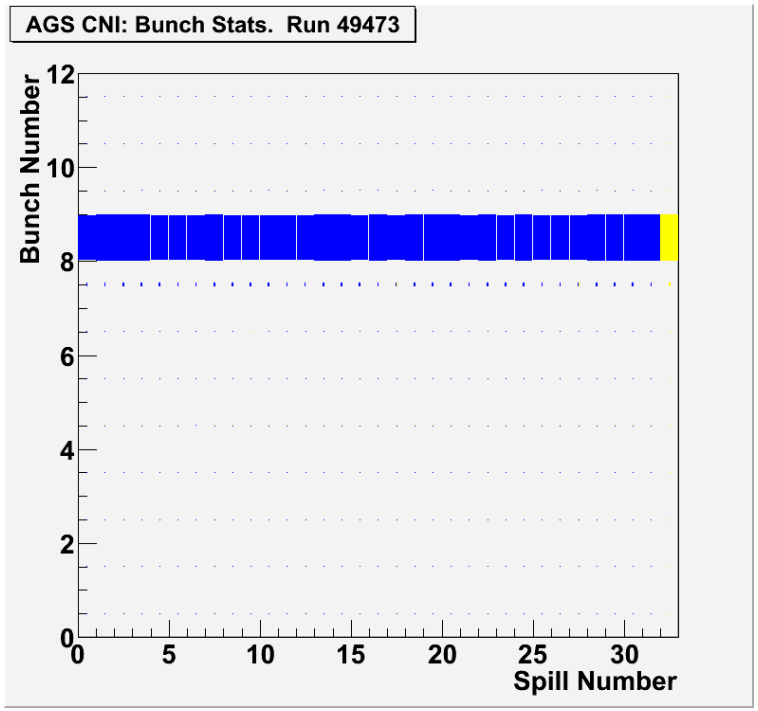
In this run beam intensity was stable but DAQ rate was not

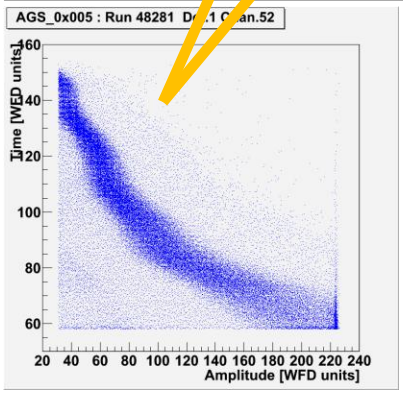


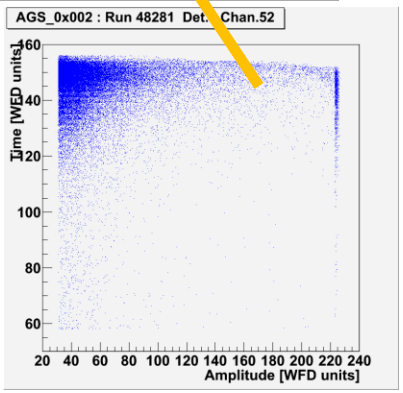


Bunch Selection





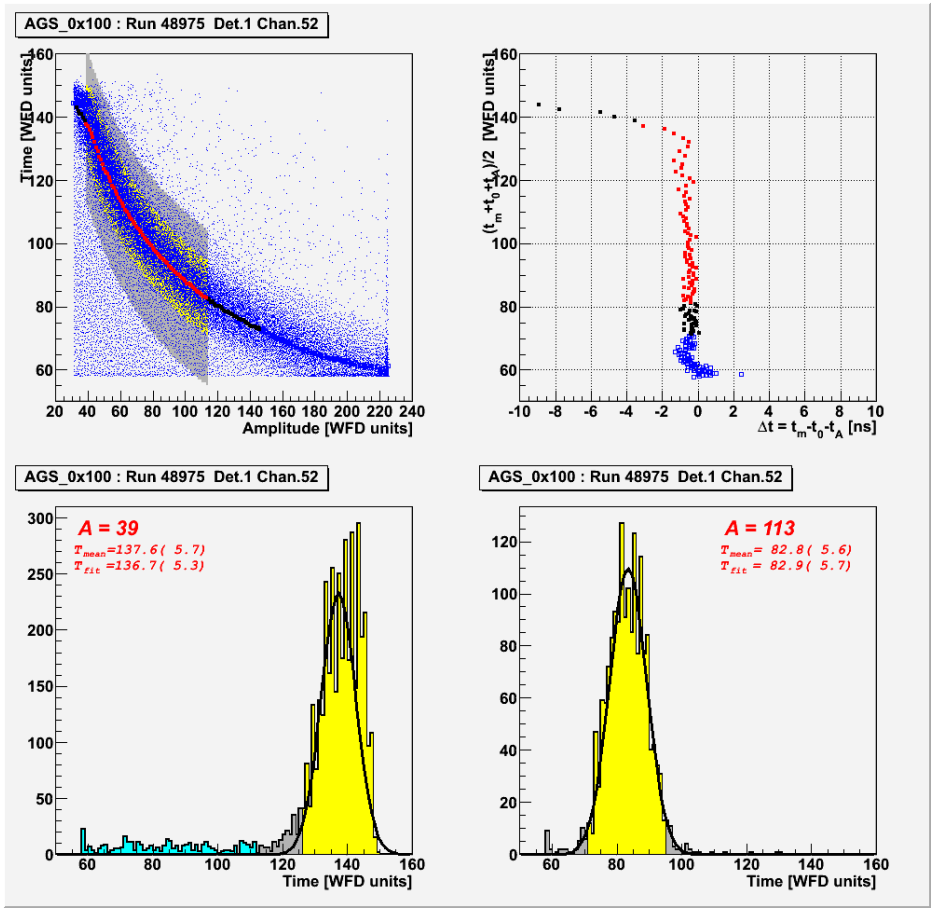




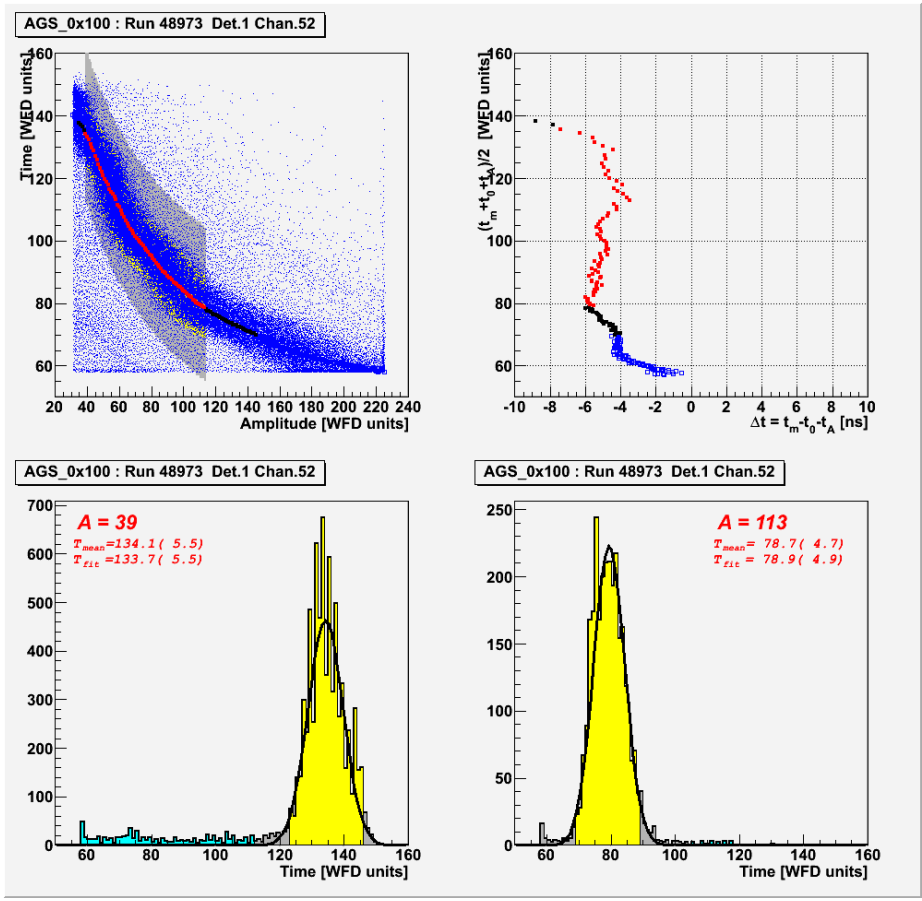
Wrong Bunch Number identification in the DAQ was caused by noisy rev-tick signal.
(Fixed 02/07/2011, Runs>48494)

Event Selection

Low Intensity (0.22×10^{11})

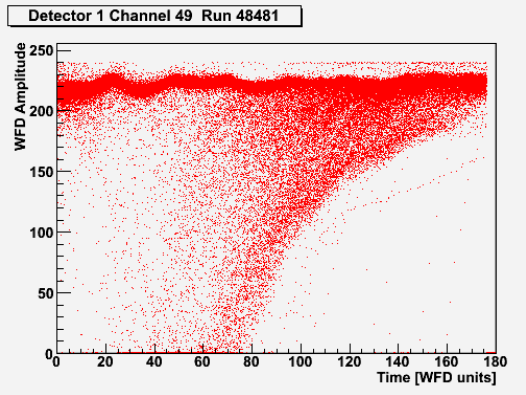


High Intensity (1.35×10^{11})



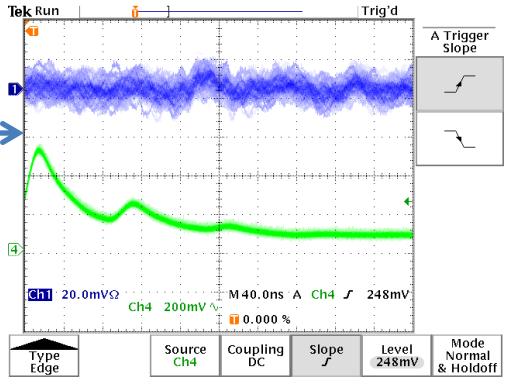
- *Time measurement is intensity dependent .*
- *It may result in wrong energy calibration.*

Induced Pulse (correlated with bunches)



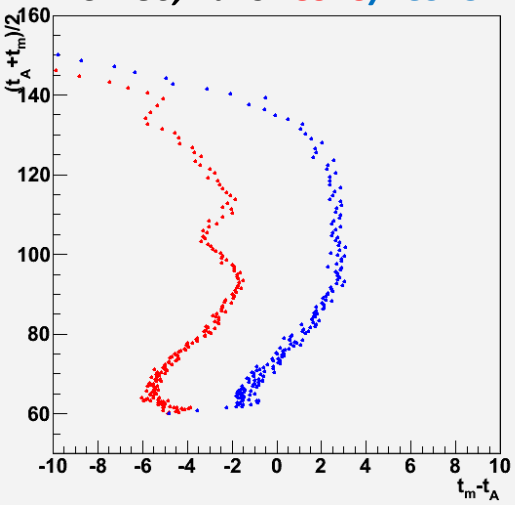
WFD view

Oscilloscope

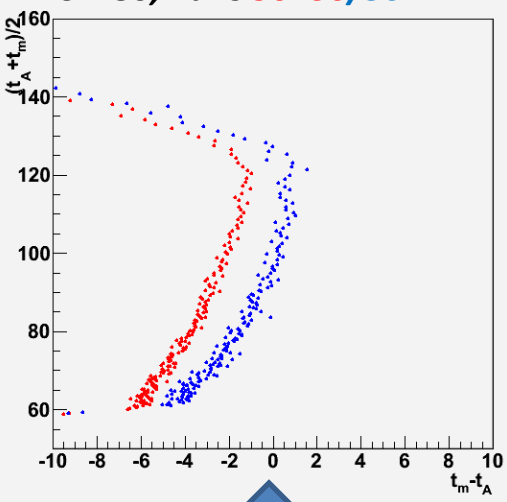


Since signal amplitude and time are strictly correlated such a noise results in sytematic time (amplitude) dependent errors of measurements

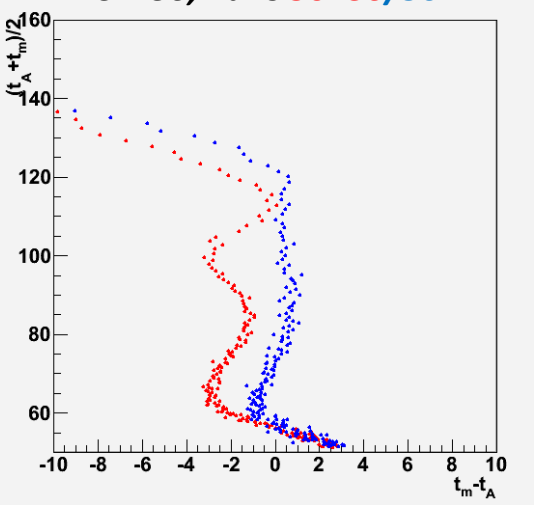
Ch. 86, Runs 48973/48975



Ch. 86, Runs 50236/50242



Ch. 36, Runs 50236/50242

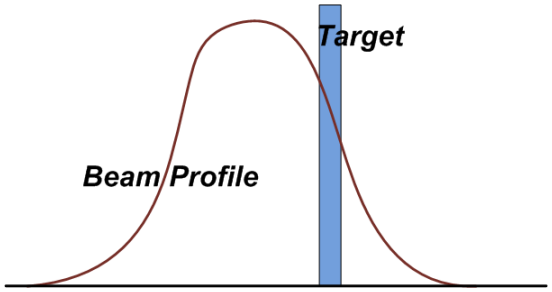


Significant improvement after change of detector grounding

Rate/Intensity ratio

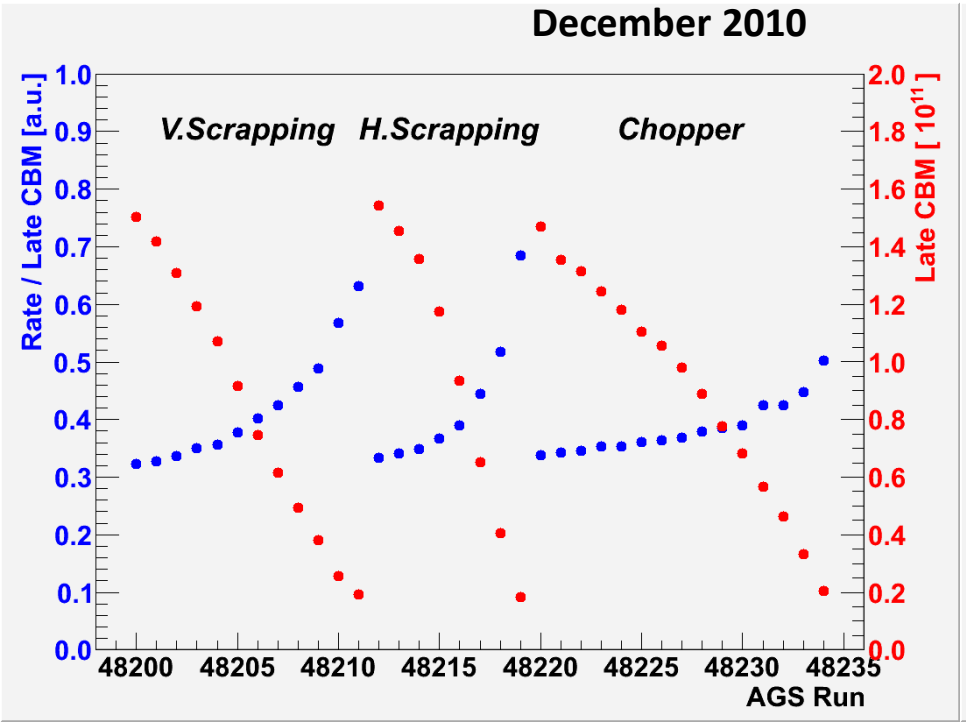
Rate/Intensity ratio depends on

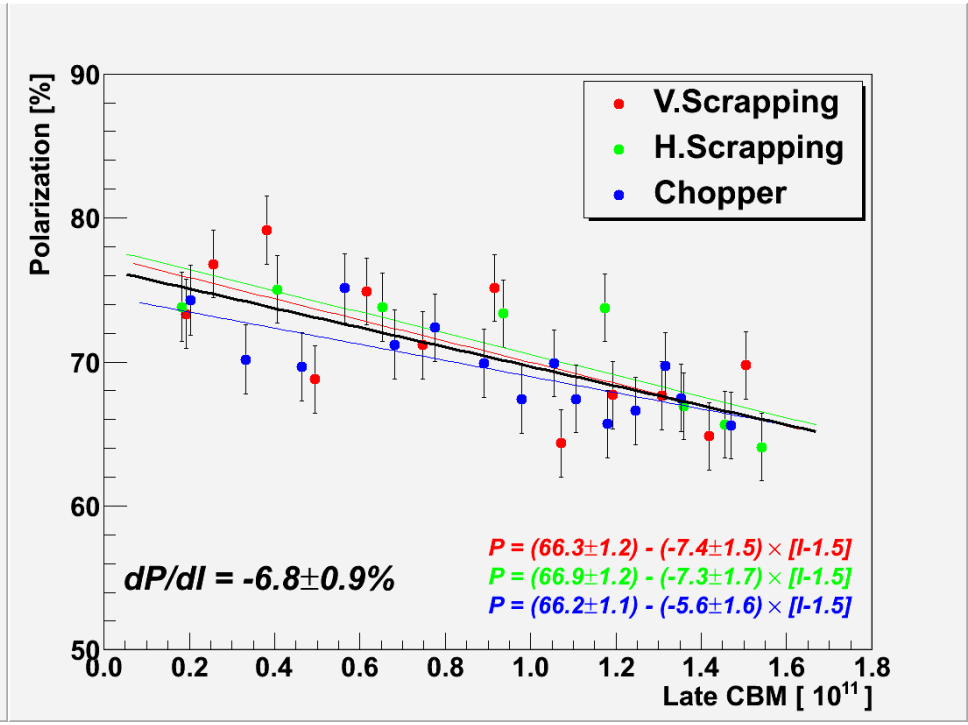
- ***Beam Emittance***
- ***Target position relative to the beam center***
- ***Target dimensions***
- ***DAQ (?)***



Rate/Intensity ratio may be used as an indicator of changing of measurement conditions

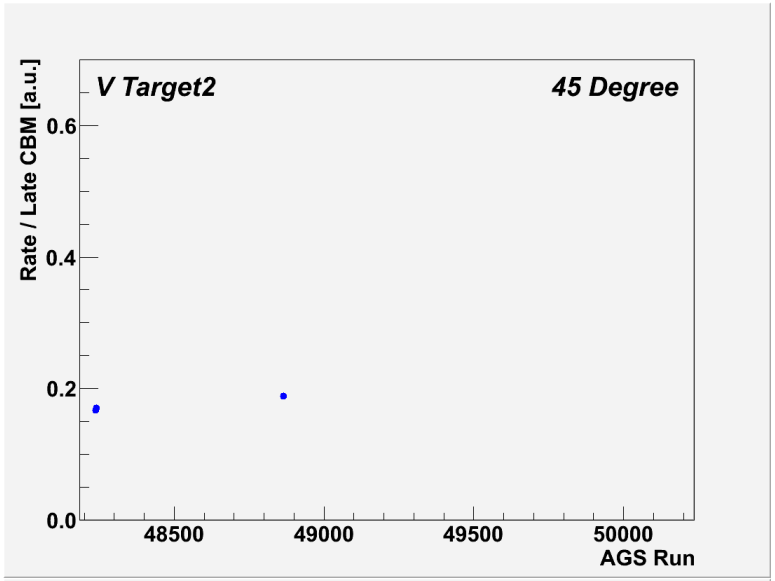
Example of Rate/Intensity dependence on Beam Emittance

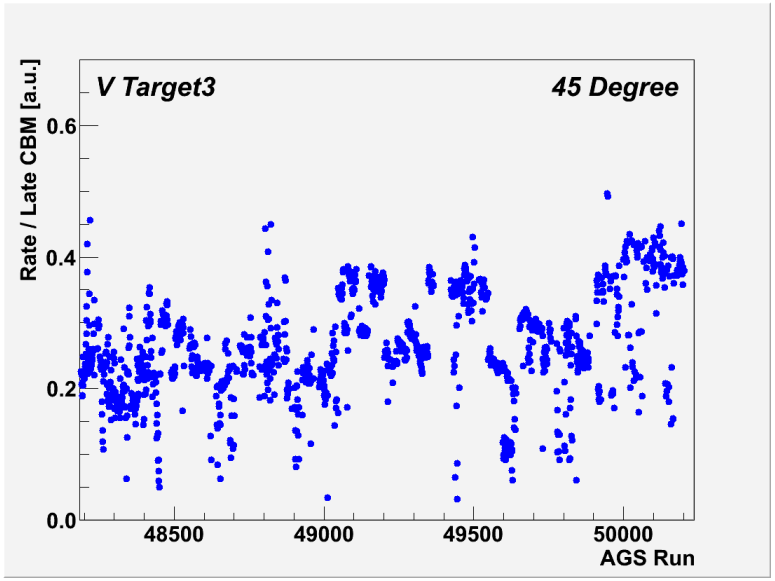


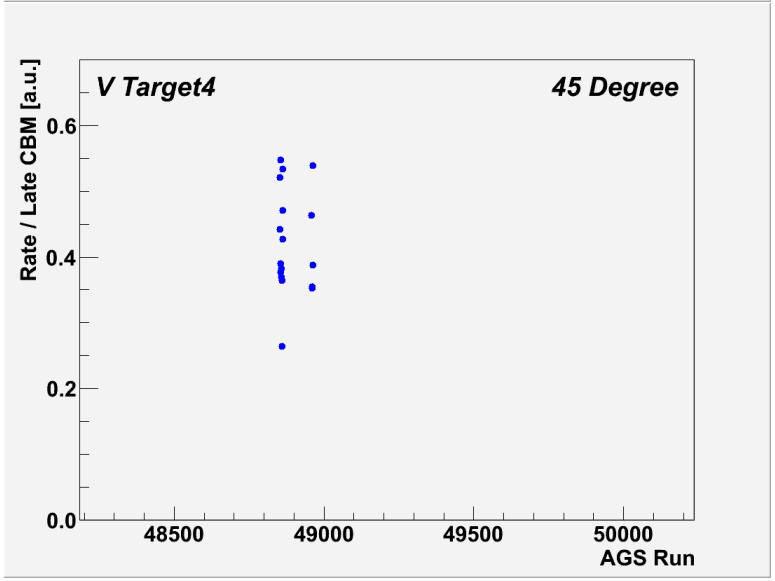


Rate/Intensity for Vertical Targets

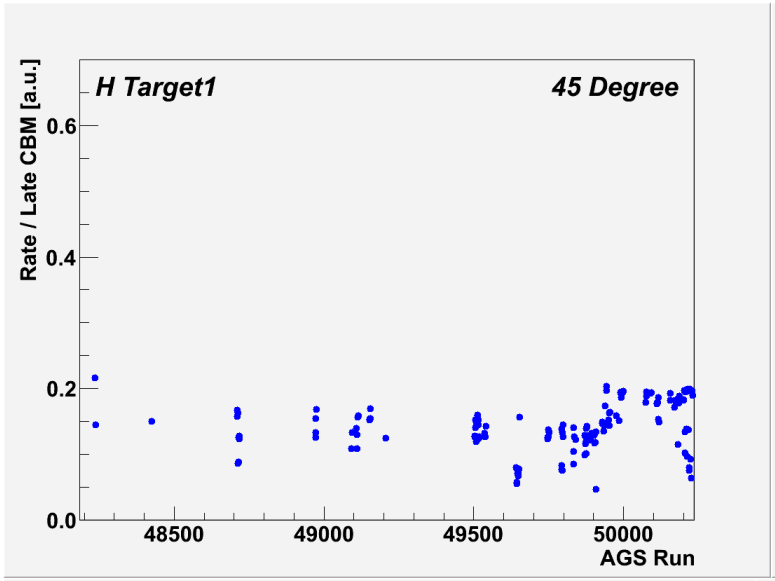
- *Most of measurements were done with V3 target.*
- *(Only) these measurements are suitable for detailed comparison of detectors types performance*

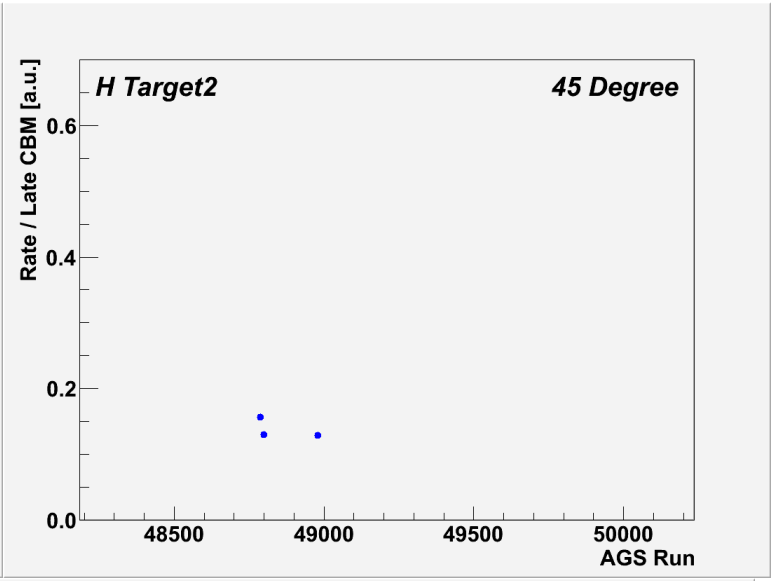


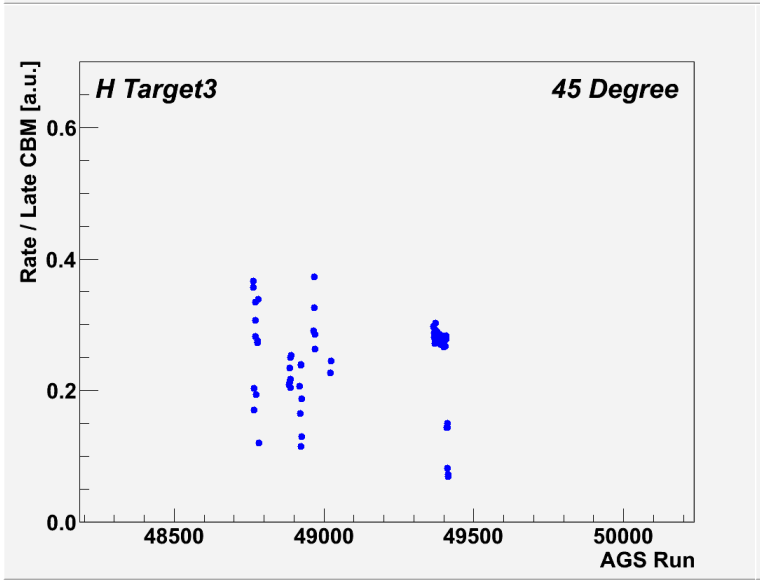


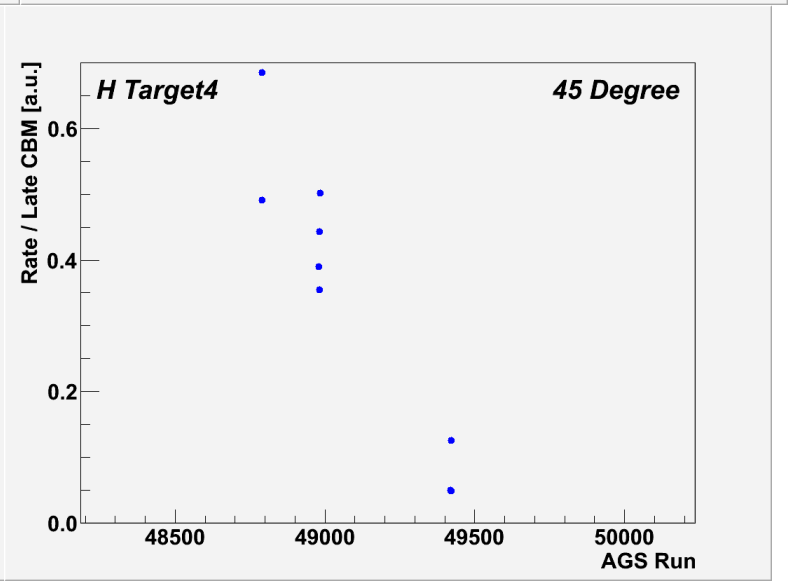


Rate/Intensity for Horizontal Targets

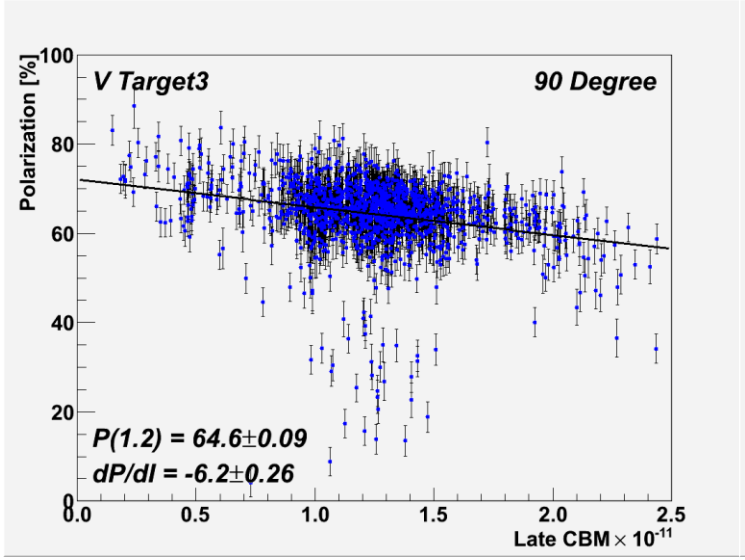


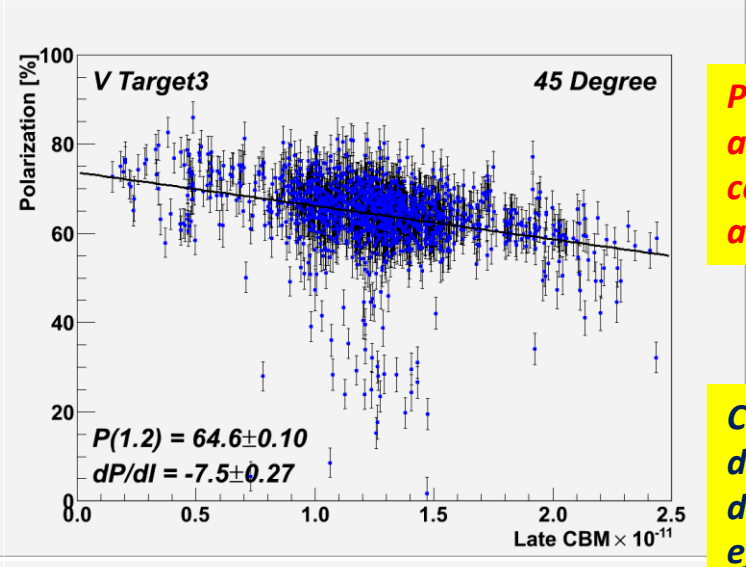


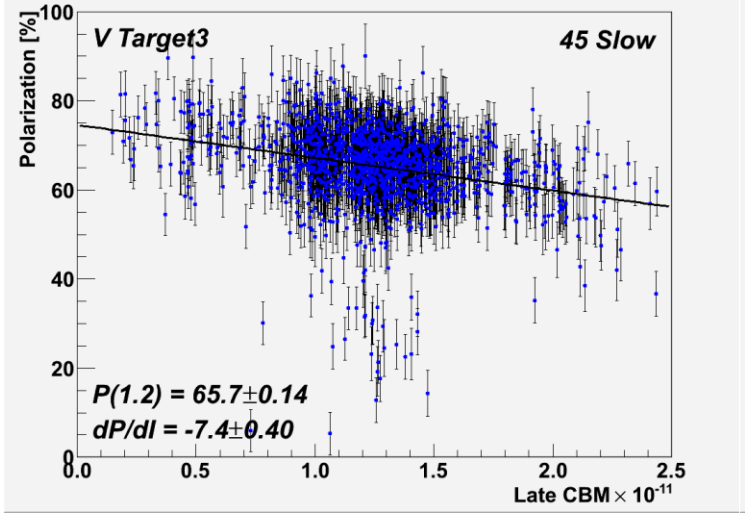


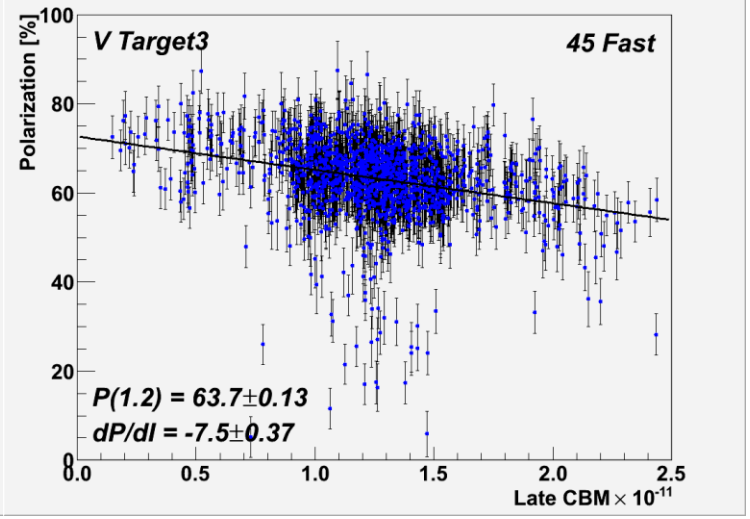


V3, all 2011 runs









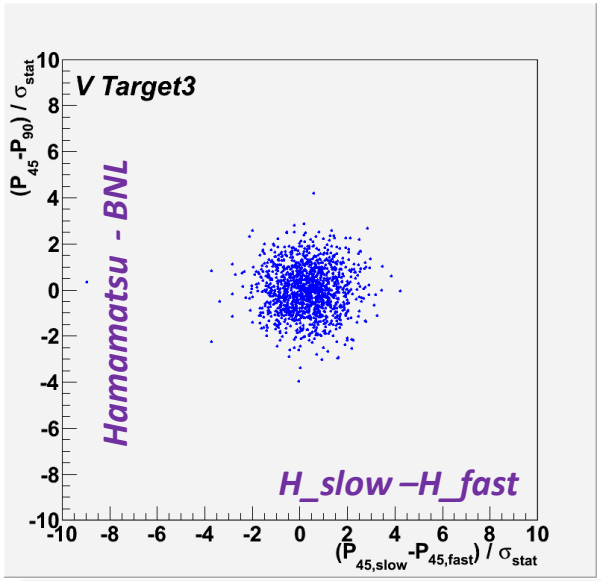
Polarization measured by all 3 types of detectors is consistent within 1-2% accuracy !

Can we explain slope difference for 90 and 45 degree detectors by rate effect ?

All data was included in the fit. Results of the fit should be used for comparison only

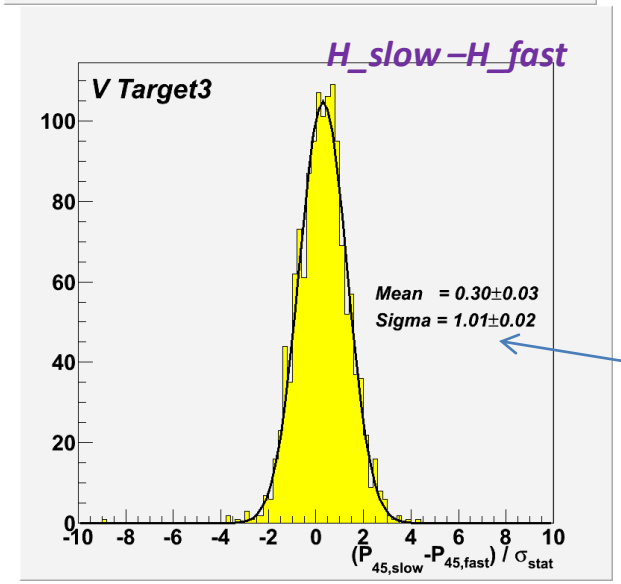
Polarization, P(1.2) , is given for intensity 1.2×10^{11}

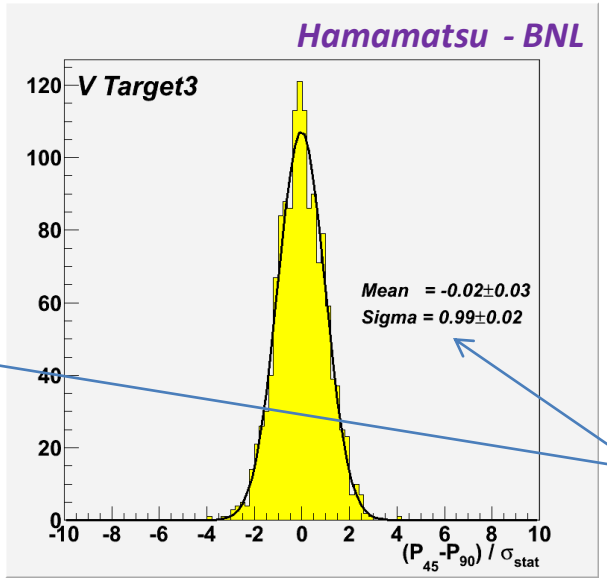
V3, all 2011 runs: Search for instability of measurements



- *There is systematic difference in polarization measurements by fast and slow Hamamatsu detectors.*
- *Systematic difference is much smaller than statistical errors.*
- *No fluctuations of the systematic error of measurements were found for all detectors.*

Normalized measured polarization difference

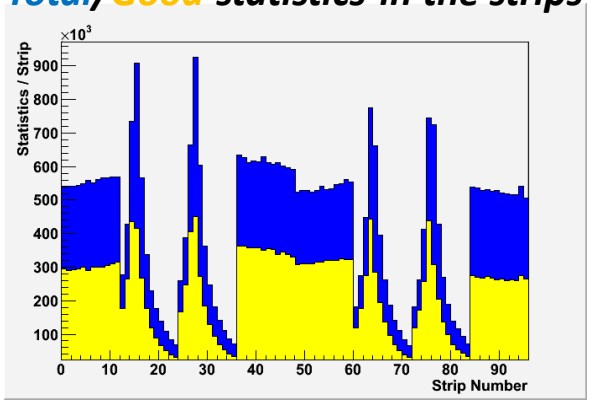




RMS of difference of measured polarisation perfectly agrees with statistical errors

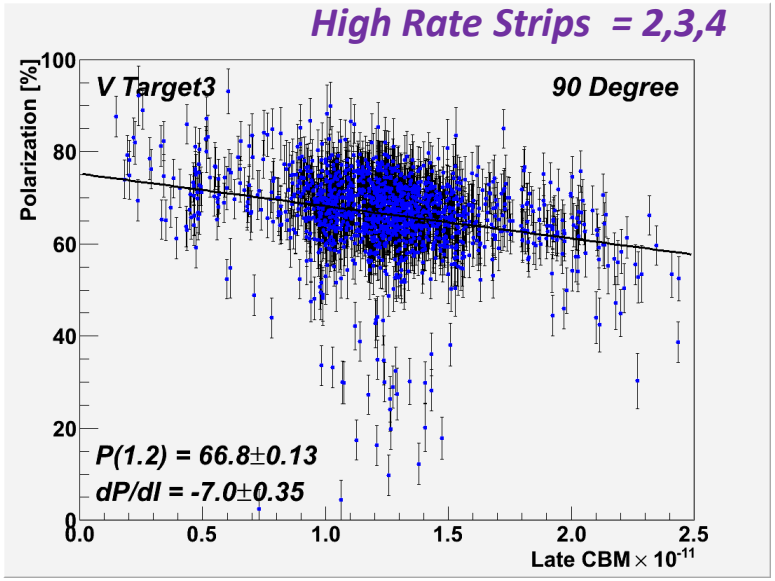
V3, all 2011 runs: Evaluation of the Rate effect

Total/Good statistics in the strips

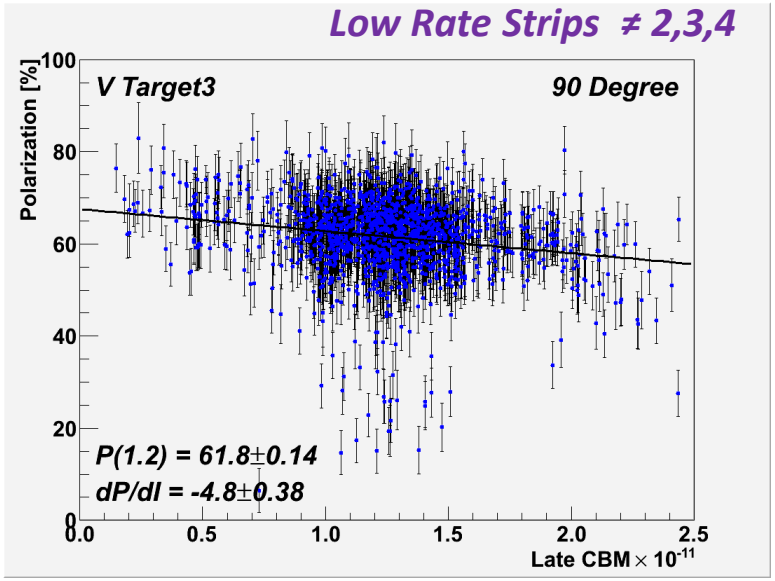


- *The estimate of the rate effect contribution to the slope:*
  -(2 – 3)%
  (recalculated for V3, 45 degree detectors)
- *Discrepancy for the mean value of polarization (a new problem to be solved)*

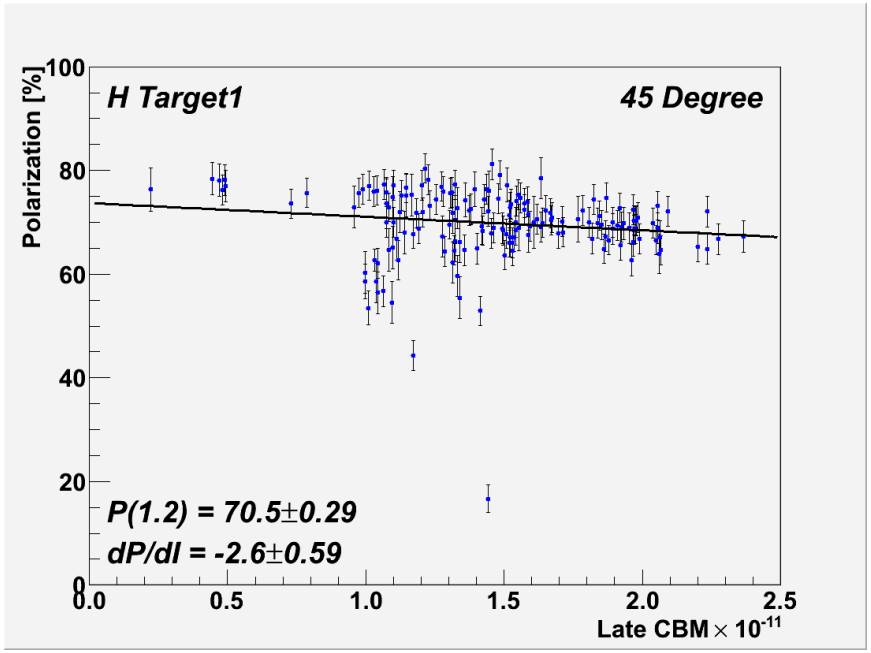
High Rate Strips = 2,3,4

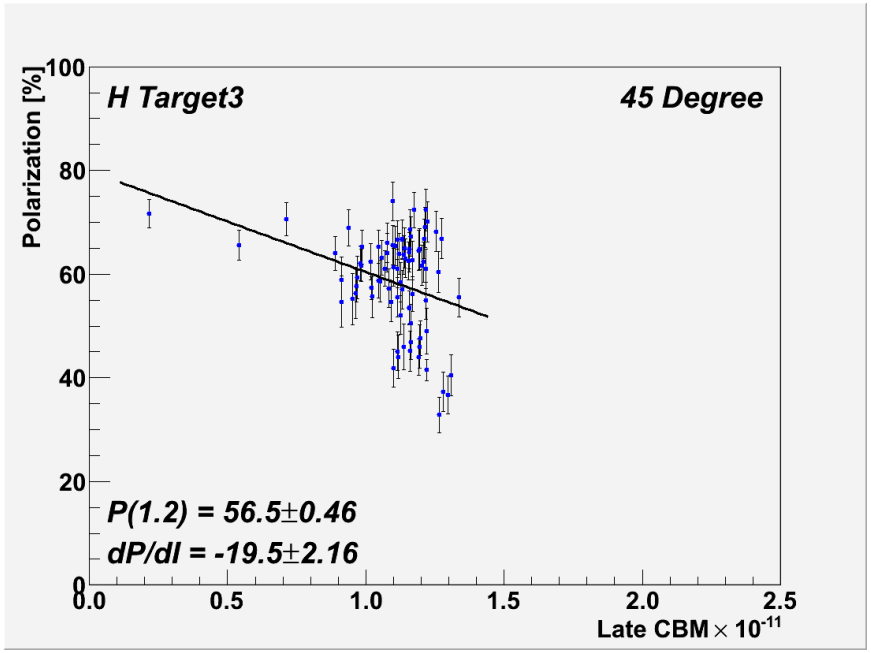


Low Rate Strips ≠ 2,3,4



Horizontal targets, all 2011 runs

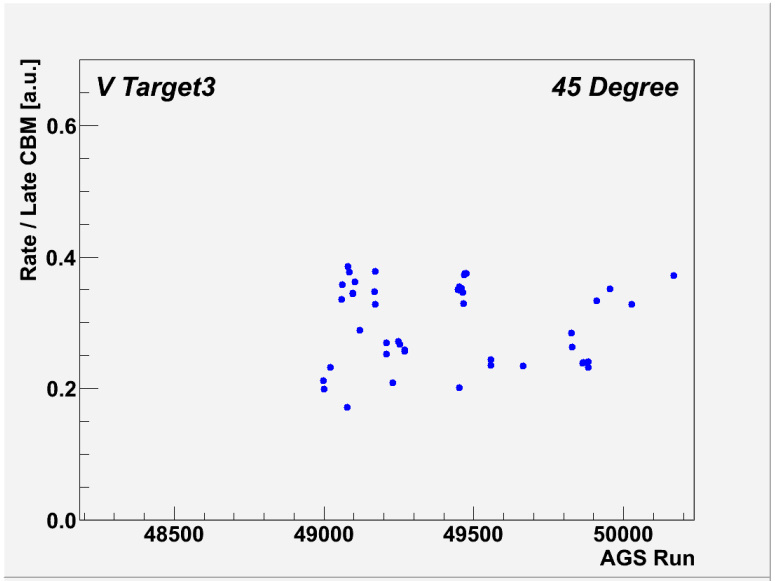


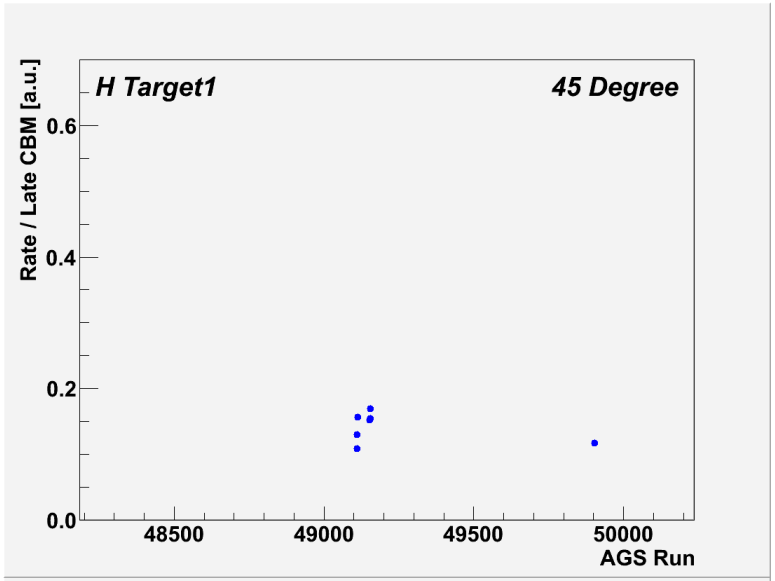


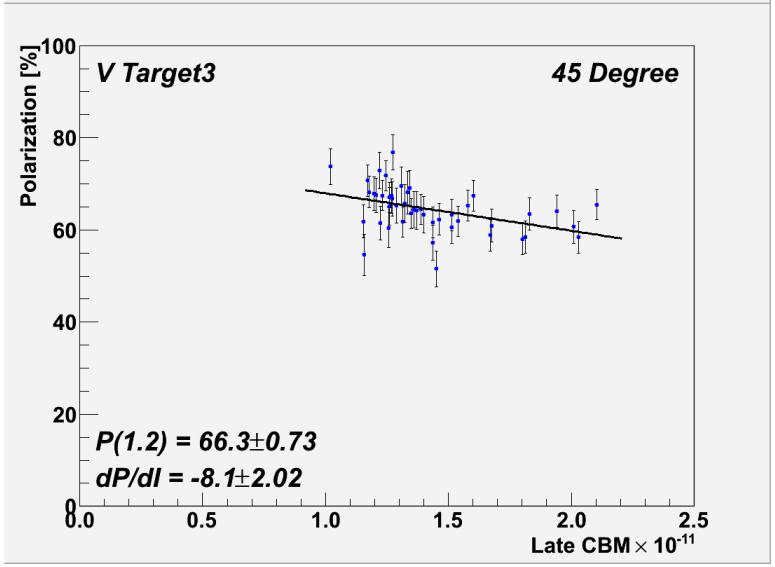
- *Targets V3, H1, and H3 should not be compared in such a way (without preselecting the same beam condition runs)*

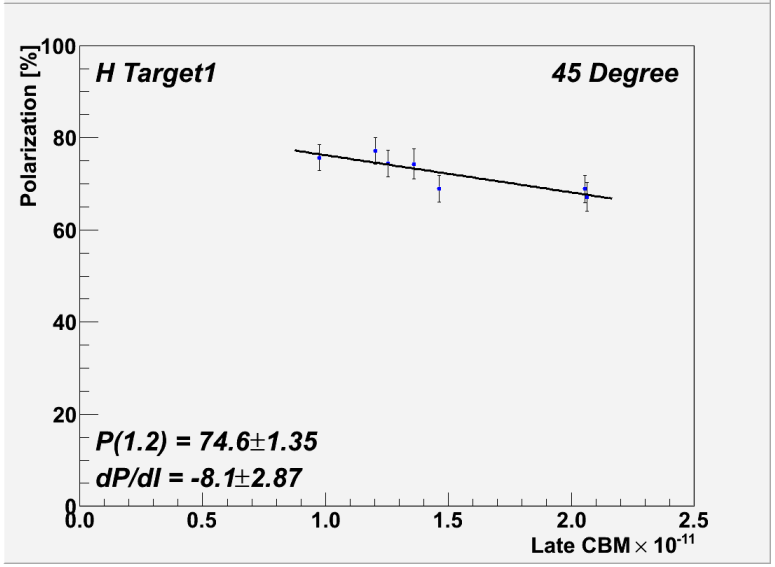
- *Nonetheless, we can point out that results of polarization measurements are target dependent.*

“Reference for RHIC fill” runs

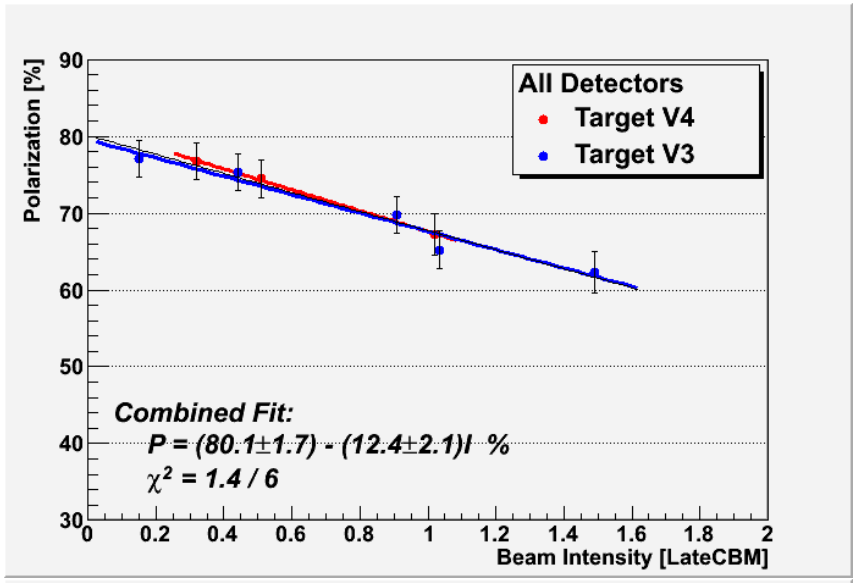


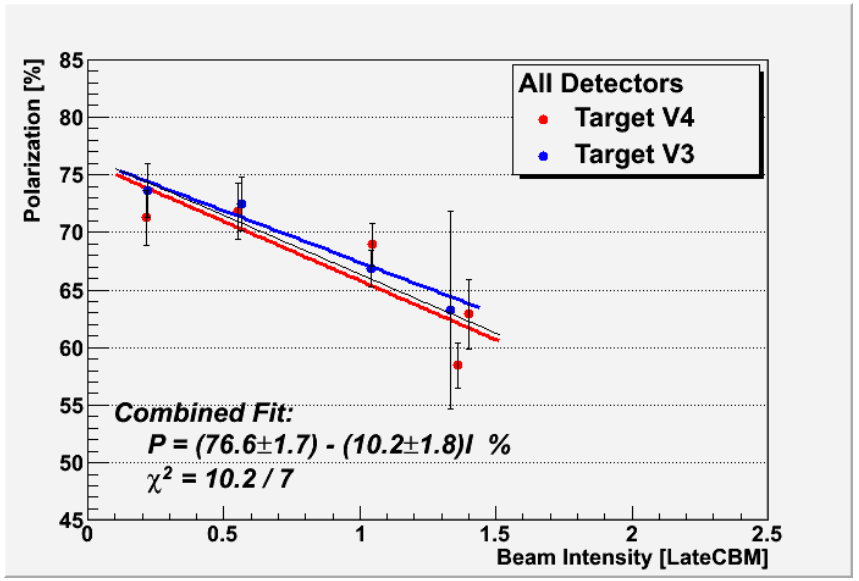


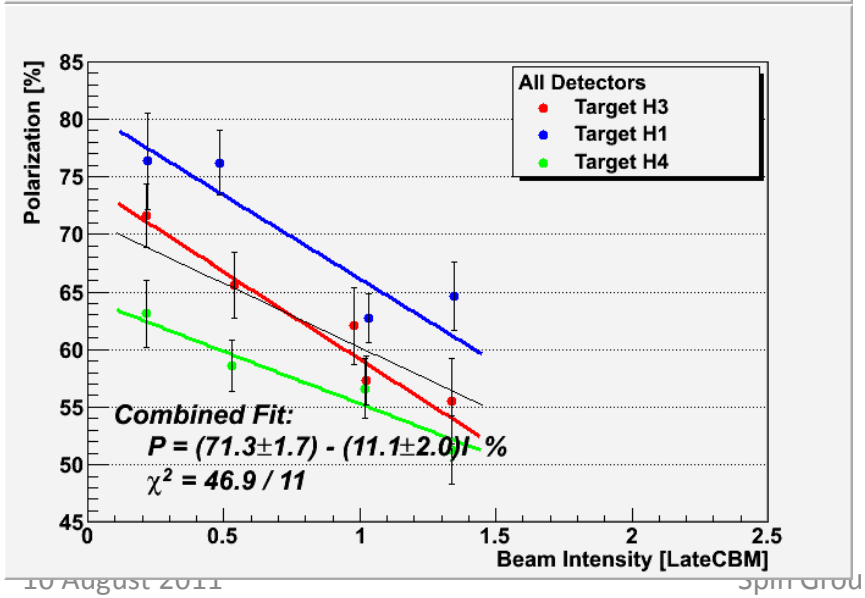




Target dependence of the Polarization measurements

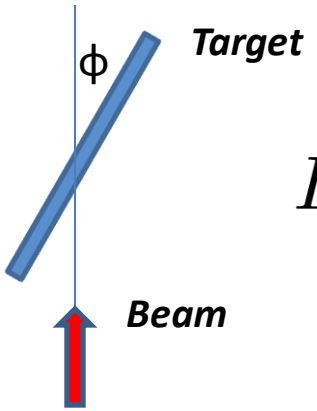




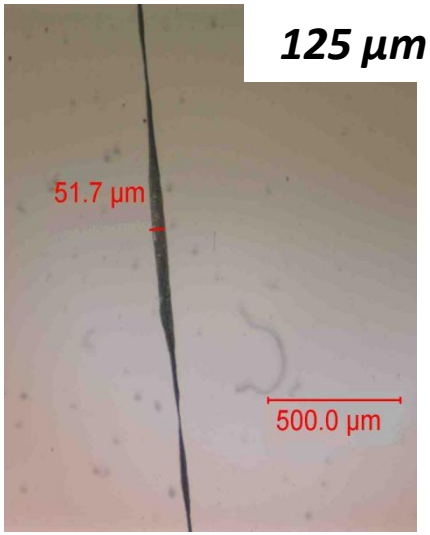


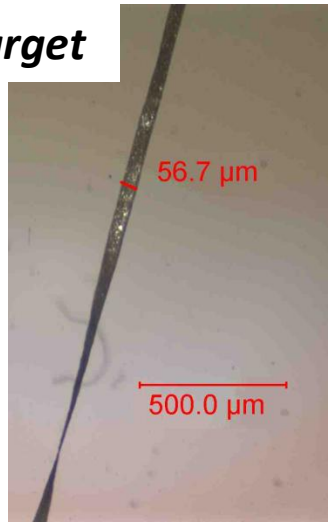
There is about 10% (relative) difference between Polarization measurements with H1 and V3 targets.

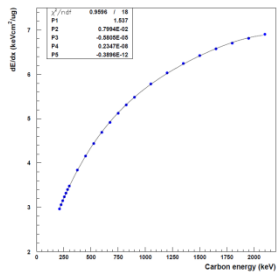
Energy losses in the target

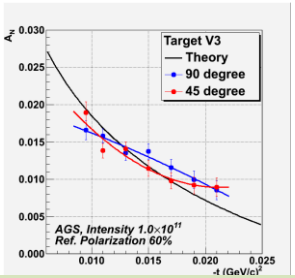


$$L = \frac{\sqrt{2}(d/2)}{\cos\phi}$$









Energy range 400-900 keV

Calculation

Measured/True Polarization

Angle	Target Thickness (μg/cm^2)		
	4	8	16
0	0.991	0.982	0.965
45	0.987	0.975	0.951
80	0.950	0.903	0.825
85	0.903	0.802	0.610
0 - 360	0.970	0.948	0.911

Effect of energy losses in the target
- ***may be strong***
- ***may be unpredictable***

Results are independent on target width !

Summary

- Spill / Bunch selection is needed for data processing
- Strong effect of induced pulse (probably a way for improvement is found)
- No difference in different type of detectors performance was found (within 1-2% accuracy)
- Rate effect was estimated for V3 target ($dP/dI \approx -(2\text{-}3)\%$)
- Polarization measurement in 90 degree detectors are strip depemdent (?!)
- No quantative explanation for target dependence of the measurements
- Energy losses in the target may be significant.

Plans

- Implement new energy calibration method
  - software is ready and was tested on RHIC data
  - veryfication of the method is still needed
- More detailed study of the target dependence of the measurements
  - measurement with wide target (to avoid twisting)
  - measurements with very narrow (RHIC) target (to suppress rate effect)
- Fast online analysis